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The Sustainability of African Debt

Daniel Cohen

The role of debt forgiveness is to alleviate what is known as "debt overhang." To what reasonable debt ratio should African debt be written down? A threshold of 200 percent is about right.

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Summary findings

The role of debt forgiveness is to alleviate what is known as "debt overhang." The core idea of the Brady deals, this concept now comes to the African debt crisis.

How can one gauge the hypothesis of the debt overhang? To what extent can one attribute the growth slowdown of the 1990s to the debt crisis of the 1980s?

Using data for the past decade, Cohen finds that debt variables play a significant role in that slowdown. In one exercise, he finds that more than half the growth slowdown of the large debtor countries in the 1980s could be attributed to the debt crisis.

To what reasonable debt ratio should African debt be written down? Most exercises set the threshold of sustainability of debt at about 200 percent. The easiest way to rationalize such a threshold is first to measure the average value of debt-to-export ratios reached at the time of the first rescheduling of debt in a given country. Using Latin America as a benchmark, one finds an average threshold of 248 percent. However short-sighted such a ratio might be, it goes a long way toward rationalizing the view that a debt-to-export ratio between 200 and 300 percent is a strong signal of a forthcoming crisis.

This naive approach takes no account of the changing environment (growth and interest rates) a country must confront. A more subtle approach should allow for the prospect of a country's growth to assess the sustainability of the debt it inherits. With Cohen's formula for so doing, Africa's debt-to-export ratio should be brought to 198 percent.

Another way to assess the sustainability of debt is to look at the secondary market, which allows one to estimate the prospect of repayment expected by market participants. Few African debts are actually quoted on secondary markets, but Cohen presents a formula for reconstructing estimates of repayment prospects econometrically. By that method, Africa's debt-to-export ratio should be 210 percent, suggesting that a threshold between 200 and 250 percent is about right.

This paper — a product of the International Finance Division, International Economics Department — is part of a larger effort in the department to highlight international economic issues that are particularly important for Africa. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Sheilah King-Watson, room N3-040, telephone 202-473-3730, fax 202-522-3277, Internet address skingwatson@worldbank.org. July 1996. (35 pages)

C.E.P.R.E.M.A.P

THE SUSTAINABILITY OF AFRICAN DEBT

by

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THE SUSTAINABILITY OF AFRICAN DEBT
Executive summary

A - DEBT OVERHANG

The role of debt forgiveness is to alleviate what is known as the "debt overhang". This was the core idea of Brady deals, and now comes to the center of the African debt crisis.

How can one specifically gauge the "debt overhang" hypothesis? What is the extent to which one can an attribute to the debt crisis of the 1980s a significant role in the growth slowdown of the 1990s? We carry such an exercice in this text. Using data that now encompasses the whole of the past decade, we do find a significant role for debt variables. Under one exercice, we find that more than half the growth slowdown of the large debtors in the 1980s could be attributed to the debt crisis.

B - DEBT THRESHOLD

What could be a "reasonnable" debt ratio to which African debt should be written down ? Most exercices set the threshold of sustainability of the debt at about 200 %. The easiest way to rationalize such a threshold is first to measure the average value of debt-to-export ratios that were reached at the time of the first rescheduling of any given country. When taking Latin America as a benchmark, one finds an average threshold of 248 %. However "myopic" such a ratio might be, it goes long way towards rationalizing the view that a debt-to-export ratio "between 200% and 300%", is a strong signal of a forthcoming crisis.

This naive approach takes no account of the changing environment (regarding growth and interest rates) to which a country can be confronted. A more subtle approach should take explicit account of the prospect of growth of one country in order to assess the

sustainability of the debt it inherits. In order to incorporate these dynamics, one can proceed with the following exercice. Taking Mexico as a benchmark, one gets the following results. At the worst of its debt crisis, Mexico transferred abroad 4.7% of its GDP. Taking account of growth and interest rate, one can calculate that it should have service 7% of it GDP to stabilize its debt-to-GDP ratio. This points to the view that its debt was one third too large. In debt-to-export terms, that points to the view that a debt-to-export worth 220% in 1985 would have avoided the crisis. Applying this methodology to African countries, we get that African debt proportionately, debt-to-export ratio should be brought to the 200% mark (more specifically to 198%).

C - MARKET VALUE OF THE DEBT

Another way to assess the sustainability of the debt is to take a direct view to the secondary market.

Secondary market allows to estimate the prospect of repayment that are expected by market participants. Few African debts are actually quoted on secondary markets but one can reconstruct by econometric methods what is the price at which the debt would be valued, if it were quoted on grounds similar to other indebted countries. We perform such an exercice, and we reach the following conclusion. In average, African debt would be worth 42 cents on the dollar if it were priced on secondary market. (Interestingly, our estimate of Ivory Coast and Nigeria two African countries whose debt is actually priced, are very similar to their actual price). One can then proceed to carry the following exercice: if the debt were to be written down to the level that would bring its price to a 25% discount, what should be the corresponding debt-to-export ratio? The answer is: 210%, which -again- suggests that a threshold between 200 and 250% is about right.

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INTRODUCTION

Many large debtors of the 1980s such as Argentina, Brazil or Mexico have found their way out of the sequence of painful reschedulings which marred for almost a decade their economic prospects.

Such is not the case of African countries. Debt remains large, and no far reaching agreement has yet been found that could open the way to a brighter future.

In this paper we try to set the foundations of the analysis of the African debt crisis by reviewing two problems. First what is the extent to which one can attribute to the debt crisis of the 1980s the growth slowdown of the large debtors ? Second, we try to address the question of defining the appropriate level of debt-to-export ratio upon which a programme of debt forgiveness could be targetted.

Regarding the first question (which we analyze in section 1), we find that the debt crisis can explain more than half the growth slowdown of large debtors in the 1990s. The other half is essentially due to the terms of trade fluctuations. The effect is especially large in Latin American but nonetheless critical in African countries as well.

Turning to the analysis of what could be an appropriate debt-to-export target, we offer three potential measures. The most naive ratio simply measures the average debt-to-export ratios of countries which rescheduled their debt for the first time. Taking Latin America as a benchmark, we get that the critical debt-to-export ratio is 250% We then calculated which debt-to-export ratio was likely to be

sustainable (by which is meant not increasing) when the service capability of debtor countries is assumed to mimick Latin America. One gets a debt-to-export threshold *below* 200% . (This is shown in section 2).

Finally, we investigated what could be a debt-to-export ratio that would allow the debt of African debt to be quoted on a secondary market at a discount not exceeding 25%. We find a debt-to-export ratio of 210%. (This is shown in section 3).

Altogether, our analysis then suggests that debt matters and that a debt-to-export ratio in between 200 and 250% is a reasonable target to alleviate the crisis.

1. The debt overhang

We first want to assess the correlation between debt and growth that was observed in the 1980s. We shall first investigate the extent to which the debt build up of the early eighties can be identified as an important cause of the slow down of growth during the past decade. We shall then attempt to draw more broadly the lessons of the debt crisis to assess the extent to which one should expect (in the future?) foreign finance to speed up growth in the poor countries. This will open the way to an empirical analysis of the potential efficiency gains that a debt write-off could deliver.

1 - A "Quasi Accounting" framework

We shall set up, here, a "quasi-accounting" framework which builds on the "augmented" Solow model analyzed in Mankiw, Romer and Weil (1990) (henceforth MRW) . Assume that production can be written as :

$$(1)\quad Q_t = K_t^{\alpha} H_t^{\beta} (A_t L_t)^{\gamma},$$

K_t is physical capital, H_t is "human" capital, L_t is raw labor, A_t is an exogeneous productivity term, and $\alpha + \beta + \gamma = 1$. Call I_t and Z_t the investments in physical and human capital respectively. One can write:

$$(2)\quad \begin{cases} \dot{K}_t = -\,d\,K_t + I_t & (2\text{-a}) \\ \dot{H}_t = -\,d\,H_t + Z_t & (2\text{-b}) \end{cases}$$

Call, $Y_t = (Q_t/L_t)$ output per capita, $a_t = \text{Log } A_t$, $y_t = \text{Log } Y_t$. One can log-linearize (1) and (2) as :

$$(3)\quad \frac{d}{dt} y_t = \dot{a}_t + (1-\alpha-\beta)\,(d + n + \mu)\,[\hat{y}_t - y_t]$$

in which, $\hat{y}_t$ is :

$$(4)\quad \hat{y}_t = a_t + \frac{\alpha}{1-\alpha-\beta} \text{Log} \frac{I_t}{Q_t} + \frac{\beta}{1-\alpha-\beta} \text{Log} \frac{Z_t}{Q_t} - \frac{\alpha+\beta}{1-\alpha-\beta} \text{Log}\,(d+n+\mu)$$

In MRW, $\hat{y}_t$ is taken as a proxy of the (Log of the) income per capita steady-state towards which the economy is converging. There is no ground to make such an hypothesis since $\hat{y}$ and can very well vary with the level of income. Equation (3) is simply obtained by differentiating (1) (around its initial value) while taking account of (2) to measure the increase of capital. It nevertheless remains the case that one can interpret equations (3) and (4) as a "quasi-accounting" framework. It is on such an interpretation that we shall draw in order to decompose the origin of the growth slowdown in the eighties.

2 - A benchmark equation

In this section, we first offer to estimate equation (3). To the extent that we want to pay a specific attention to the shift of the pattern of growth over the years, we shall pool the time averages over the following four sub-samples : 1973-77; 78-82 ; 83-87 ; 88-92. We use the Summer-Heston data (1991) and complement them with World Bank data. Z_t/Q_t is proxied by secondary school enrollment. (In Cohen 1991, I show that MRW's procedure essentially amounts to that).

The results are shown in Equation (5), in which one should read: Lpop = Log $(d+n+\mu)$, Ls_2 = Log (Z/Q), Linv = Log (s_1), Lyinit = Log (y_0), Tot = terms of trade variations, Resch is a dummy which counts the number of reschedulings that a country went through, D2 = time dummy 1978-82, D3 = 1983-87, D4 = 1988-92, Africa is a dummy for Africa, LAAM is a dummy for Latin America, and Ldet the Log of the debt to GDP ratio at the beginning of 1983 and 1988. One obtains:

$$\begin{array}{l} (5)\ g = -0.11 - 0.025\ \text{Lpop} + 0.0036\ Ls_2 + 0.032\ \text{Linv} + 0.0088\ \text{ToT} \\ \qquad\quad (-2.9)\quad (-2.0)\qquad\quad (1.3)\qquad (6.0)\qquad\quad (2.1) \end{array}$$

$$\begin{array}{l} -0.057\ \text{Ldet} - 0.02\ \text{Resch} - 0.086\ \text{Ln(Yinitial)} - 0.008\ \text{d2} \\ (-2.5)\qquad\quad (-2.9)\qquad\quad (-3.6)\qquad\qquad\quad (-1.8) \end{array}$$

$$-0.0051\ d3 + 0.0025\ d4 - 0.017\ Africa - 0.007\ Laam$$
$$(-0.95) \qquad (0.44) \qquad (-2.1) \qquad (-1.5)$$

$$R^2 = 0.37$$

The main result which appears from this regression is the very significant role of the debt crisis. Both the debt and the number of reschedulings are significant variables (and dropping one would reinforce the explanatory power of the other). A key feature of this regression is that it explains the growth slowdown of the eighties remarkably well: as one sees, the time dummies are not significant.

There is clearly a key problem in interpreting this regression in causal terms. It can very well be the case that the slowdown of growth (for whichever reason) *caused* the country's debt problems. Furthermore, it can also be the case that the effect of the debt crisis is quite different on middle-income debtors and low-income countries. One can respond to these questions as follows. For one thing, the debt variable itself is a beginning-of-period variable, so it is immune, to some extent, the risk of reverse causality. Furthermore, when attempting to differentiate the African debt from other countries' debts, (by interacting the debt variable with an African dummy) one does not find a statistically significant difference emerging. One can also point to the fact that we control for the main alternative factor that could cause the growth slowdown, namely the terms of trade, which indeed turns out to be significant although not outstandingly.

It is also crucial to note that this growth equation is obtained through "conditional dynamics" that take account of the investment decision. It is therefore *not* the shift of investment which explains the slowdown of growth that we are identifying but a loss of "productivity" (which obviously must take account of the fact that the recession of the early eighties has pushed the economies within their production possibility frontiers). One then wants to get an additional equation that explains the slow down of investment itself. In order to get a measure of this factor, we have then estimated an investment

equation which is conditionned on the same variables as the growth equation and a term OPEN which measures the degree of openness (export + import ratios) of the country. The results are shown in equation (6).

$$\text{(6) Linv} = \underset{(1.5)}{-2.47} + \underset{(0.7)}{0.02\ Ls_2} + \underset{(2.3)}{0.055\ \text{Lyinit}} + \underset{(5.1)}{0.53\ \text{Open}} + \underset{(2.7)}{0.13\ \text{ToT}}$$

$$\underset{(-2.2)}{-0.030\ \text{Resch}} + \underset{(1.1)}{0.06\ \text{d2}} - \underset{(-1.1)}{0.06\ \text{d3}} - \underset{(0.1)}{0.005\ \text{d4}} - \underset{(-4.0)}{0.24\ \text{Africa}}$$

$$\underset{(-3.2)}{-0.15\ \text{Laam}}$$

$$R^2 = 0.33$$

We are now in a position to analyze the causes of the growth slow down in African countries. The aggregate results are reported in table 1, in which the comparison to Latin America is also reported. Country specific data are reported in table A1 in appendix.

	Worldwide recession	Structural shift	Role of Investment
Africa	- 0.27	+ 0.19	- 0.23
Latin America	- 0.27	+ 0.35	- 0.35

	Debt crisis	Terms of trade	Residual	Total growth Slowdown
Africa	- 0.50	- 0.54	+ 0.35	- 1.01
Latin America	- 1.18	- 0.05	- 0.13	- 1.54

TABLE 1: CAUSES OF GROWTH SLOWDOWN

We compare the second half of the eighties to the second half of the seventies (for simplicity the eighties and the seventies). We find that African (average yearly) growth lost about 1% in the eighties compared to the seventies. Our model predicts a reduction of 1.3%, so that one can interpret the unexplained residual as a better than predicted total factor productivity performance. The explained growth slow down comes as follow: about one third (0.54) is explained by the debt crisis, one third by the terms of trade, investment explains about a forth, and the remainder comes for the interaction of world recession (-0.27%) and domestic structural variables, school enrollements and fertility (+0.19%). This picture can be readily contrasted to Latin America, which suffered little aggregate terms of trade troubles, but a much more severe debt crisis.

Turning then to investment, one sees that it fell by about 21%, which is fairly well explained by our model. The origin of the fall is first and foremost a worlwide phenomenon (-12%), with terms of trade and the debt crisis explaining the remainder. Here one sees that the debt crisis is a more powerful explanation (-7%) than the terms of trade (-3%).

2. DEBT SUSTAINABILITY AND GROWTH

I - THE SOLVENCY OF A GROWING ECONOMY

Let us first try a direct exercice. Take the case of a growing economy which inherits a stock of debt that it has to service over an infinite future. Assume that the economy is in a stationary environment (ie, neglect the fluctuations of terms of trade and growth). How can one calculate the level of sustainable debt, ie the level of debt that is consistent with the pattern of growth of the country?

One first easy test is to calculate the fraction b of the country's ressources that have to be allocated to the service of the debt in order to stabilize the country's debt-to-GDP. Call D/Q the debt to GDP ratio, r the interest rate and n the country's growth rate. One can then simply write:

$$b = (r-n)\frac{D_t}{Q_t} \qquad (5)$$

Were the country willing to service more than b, then the debt-to-GDP ratio would fall. But if the country was not willing to pay such a ratio, then for sure, the debt-to-GDP ratio would rise indefinitely and the debt would sooner of later become unsustainable. How should we think of the highest possible b that a country should be willing to service ? In appendix, I summarize a model (developped in Cohen, 1994) in which the upper value of b is simply the cost λ of debt repudiation, i.e. the fraction of a country's ressources that would be foregone were it had to go at war with its creditors. λ is a number which is fairly theoretical. Yet, one can infer its value by the observed behavior of countries which have been pushed to the "limit" by their creditors. If I observed that debtors countries will never repay more than -say- 5% of their output *when* they get constrained to service then debt, I can draw indirectly the upper bound to the debt-

to-output ratio.

Before getting more specifically into such calculations, one must give a few words of caution over the meaning of such exercices for the African countries. For one thing African countries are not *yet* constrained : they keep receiving *inflows* from the rich countries : there is consequently no reason for them to even think of debt repudiation. The question that our exercice addresses is the following: what is the level of debt that they would rather service than repudiate when (if) the time comes for the creditor to get reimbursed. If the creditors keep granting subsidies to these countries, then the debt will never be repudiated, but then, clearly, it is not a debt either : it is simply a fictitious accounting device for grants. Addressing the issue of debt sustainability in the African context should perhaps simply be interpreted as an attempt to draw a line between market debt and grants in which the latter include both the explicit grant element of loans, and the implicit (forthcoming) debt write-off of that part of the debt which is not sustainable.

The second warning about Africa is about the use of the interest rate that should be used when writing equation (5) and about the definition of the debt. First the debt must clearly be corrected for the grant element that is encompassed in the low interest rate that it usually charged. But, second, it should also be clear that one wants to use the market rate of interest as a discount factor and not the concessional rate that these countries have usually access to. Indeed, to repeat, the exercice that we carry on is one in which we want to separate the debt stricto sensu from the flow of aid that a country receives.

Empirical implications

One can first try to see, on historical grounds, the critical level of debt-to-GDP ratios at which the countries started to reschedule their debt. This is shown in Table 5. One sees that, in Latin America, the debt crisis was started at a level of debt-to-export of 250%. *Ceteris paribus*, one can then say that a debt-to-export ratio of 250% becomes unsustainable.

Besides this naive definition, one can go further and calculate the values of b (as defined in equation (5)) corresponding to the debt of African and Latin American debtors. This is done in tables A2 and A3. In Latin America the average value of b is around 8% . In Africa, the values of b are not much different in average, at about 8-9%, but wide differences between Cote d'Ivoire at 16% and Botswana at 1% are noteworthy.

As a measure of what a country "could" pay (ie as a measure of the revealed cost of debt repudiation, if one wants) one can observe what the Latin American countries did actually transfer in net terms to their creditors during the eighties. These numbers are shown in table 4. Taking Mexico as the "median" debtor, one finds that net transfers never exceeded 5.5% (in 1986), and averaged 4.7% during the tense episode of 1984-89. Taking the period 1985-88 as a reference, this indicates (in the most favorable interpretation) that Mexican debt was one third too high. This implies that a debt-to-export ratio worth 220% would have been sustainable in 1985. Clearly, this is a very partial story, but it has the merit of an easy interpretation. Under the toughest circumstances, Mexico transferred no more than 4.7% of its ressources to its external creditors. This 4.7% number can therefore be taken as a benchmark of what a "typical" large debtor would rather pay than defaulting on its debt.

Let us then apply this 4.7% benchmark to Africa. Regarding the African SILICs, (Severely Indebted Low Income Debtors) one finds an average value of b of 12.8%. Assuming that they would never transfer more than 4.7% of their ressources abroad, this points to the view that debt is too high by a factor of 2.7. Applying this ratio to the debt-to-export of SILICs, one finds that the debt to export should be scaled down to about 200% (198% to be accurate) to meet Mexican standard of sustainability.

3. The secondary market price of African debt

The approach above is clearly too naive inasmuch as it assumes that countries have reached a stationary environment and takes no account of other characteristics such as varying degrees of openness, uncertainty and the forth.

One more direct way to look at the issue could be to extract from secondary markets the information regarding these various influences such as prospect of growth, openness,... on the value of the debt. However, most African debt is held by government or IFIs and is consequently not quoted on secondary market. It is then not possible to draw from the markets a direct evaluation of the price of African debt. Drawing upon an econometric analysis of the debt which is actually quoted on these markets, one can nevertheless attempt to reconstruct what price the market would assign to African debt if it were to be quoted. Furthermore, drawing on the key distinction between average and marginal growth that has been emphasized by Bulow and Rogoff, one can estimate how much resources would actually be surrendered by the holders of African debt, if it were to be, say, cut by half. As we shall see, this latter exercice yields quasi negligible number. From the rich countries' tax payer money, a substantial reduction of African debt would not be much a loss.

Most of African debt is held by government or IFIs and is consequently not quoted on secondary market. It is then not possible to draw from the markets a direct evaluation of the price of African debt. Drawing upon an econometric analysis of the debt which is actually quoted on these markets, one can nevertheless attempt to reconstruct what price the market would assign to African debt if it were to be quoted. Such is the goal of the present section.

I - A THEORETICAL BACKGROUND

To set up the ideas in an explicit model, consider a simple two periods model of a country which owes a debt at time t=2. Assume that the country always has the option to repudiate its debt and also

assume that the banks can (credibly) impose - in retaliation- a sanction that amounts to a fraction λ Q of the country's income. Finally, assume that the banks can always get the country to pay that fraction λ Q that the country would forego by defaulting. Call dF(Q) the density of the (random) distribution of the country's income. Let us take the banks to be risk-neutral and (for simplicity of notations) take the riskless rate to be nil. One can write the market value of a debt whose contractual value is D to be :

$$V(D) = \left[\int_0^{D/\lambda} \lambda Q \, dF(Q) + \int_{D/\lambda}^{\infty} D \, . \, dF(Q) \right]$$

The first term in the bracket represents how much the banks can get when the income of the country is so low that the country would rather default than servicing the debt fully (λ Q$\leq$ D). The second term measures the expected payments that accrue to the banks when the country honors the contractual value of the debt (an event which as a probability 1-F(D/λ)). (This model and its extensions are exposed at greater length in Cohen 1991; see also Eaton, Gersovitz and Stiglitz, 1986.)

The market price of the debt (such as observed on the secondary market) can simply be written as :

$$q(D) = \left[\int_0^{D/\lambda} \frac{\lambda Q}{D} \, dF(Q) + 1\text{-}F\,(D/\lambda) \right]$$

If a country were, say, to repurchase one dollar of its debt on the secondary market, this is the price that it would have to pay. If instead the country wants to repurchase an amount B and is *known* to be willing to do so, then -as Dooley (1989) first pointed out- the price at which the transaction will be undertaken can only be the *ex-post* equilibrium price. (Otherwise, no lenders will actually sell its claim). One then gets that the price for the transaction has to be :

$$q(D\text{-}B) = \left[\int_0^{(D-B)/\lambda} \frac{\lambda Q}{D-B} \, dF(Q) + 1\text{-}F\,[(D\text{-}B)/\lambda) \right]$$

Obviously, if a debtor country is known to be willing to repurchase *all* of its debt (B=D) then the only price at which the transaction will be undertaken is q=1.

This crucial remark makes it very undesirable to set up, say, an institution -endowed with a given amount of money- which would operate openly to repurchase LDC debt. Such an institution would immediately raise the price and defeat its own purpose.

The point which is made by Bulow and Rogoff (1991) radicalizes this critique. Assume that the country (or an institution acting on its behalf) repurchases a small fraction of the debt so that, say, the measure the benefit that is captured by the country. For the country, what matters is the reduction of the market value of the debt, i.e :

$$\rho(D) \equiv V'(D) = 1\text{-}F(D/\lambda)$$

which is strictly (perhaps much) lower than q(D). So even if the country was repurchasing a fraction B of its debt one dollar after the other, repeatedly taking the creditors by "surprise" (i.e they never expect that the next dollar will be repurchased, but they always know -at each point in time- what is the exact stock of debt), it would still be over paying its debt since it would pay :

$$\rho = \int_{D-B}^{D} q(D)\, dD$$

which is strictly more expensive that :

$$\Delta V = V(D) - V(D-B) = \int_{D-B}^{D} \rho(D)\, dD$$

Bulow and Rogoff concluded that this wedge between the cost of a debt buy-back and its real effect on the market value of the debt makes it unlikely to turn buybacks into a profitable investment. Does this reasoning apply to the debt crisis of the 30s and lead to interpret the large buy-backs which were then performed as an unworthy investment? Not necessarily. As we pointed out in Cohen and Verdier (1995) a buy-back can be good if it is done *secretly*. If -say- Morgan

repuchases Brazil's debt -held by Citicorp- on Brazil's behalf without revealing for whom the purchase is made, there are no limits to the extent of the repurchases which can be made by Morgan at the given price. (It is only when Brazil's actions are discovered that the price rises since only in that case the reduction of its outstanding external debt raises the price.) Obviously, in the thirties, the Latin American buy-backs were only revealed *after* they were completed.

Yet, as far as the open buy-backs such as those that the Brady deal encourages, it is obviously crucial to make sure that the price at which the buy-back is undertaken is appropriately priced. This involves a comprehensive *ex ante* agreement with the creditors, so that none of them can free-ride on the others. This is exactly what the Brady deal has done. In a process called "novation", it was agreed that all the previous debt had to be exchanged against one of the three options which were open. (On this point, see Diwan and Kletzer, 1990, and Demirguc-Kunt and Fernandez-Arias, 1992).

In order to evaluate empirically how the Brady deal has worked I will first analyze how the distinction between average and marginal price can be reconstructed empirically.

2 - Econometric estimates

Previous econometric estimates of the secondary market involve, Fernandez and Ozler (1991), Huizinga and Ozler(1992) or Cohen and Portes (1990). I will rely here on the price of 20 middle income countries for which the transactions are relatively frequent. (Cf. *Financial Flows to Developing Countries*, Dec.91). The data are pooled over the years 1987, 89, 90, 91, 92 and 93.

To the extent that we are interested in distinguishing the average and the marginal price of the debt, we want to estimate a price equation which yield explicitly such a distinction. Following my earlier work (Cohen, 1992) I will use a logistic function of the prices to account for this discrepancy. Specifically, I estimate z:

$$z = \text{Log } \frac{q}{1-q}$$

as a function of the degree of openness (OPEN), the log of total debt (LDET2), the number of reschedulings since 1985 (RES85), the terms of trade (TOT), the predicted value of growht (G2) such as arising from equation (1) and a dummy for Peru (PER), Poland (POL) and Bulgaria (BUL). The results are shown in equation (3).

$$\begin{aligned} \text{LPFIN} = {} & 3.032 + 4.95\ \text{OPEN} - 1.44\ \text{LDET2} - 0.357\ \text{RES85} + 1.55\ \text{TOT} \\ & (1.07)\quad (2.76)\qquad (-4.30)\qquad (-2.80)\qquad (1.37) \\ & + 40.13\ \text{G2} - 2.65\ \text{PER} - 1.52\ \text{POL} - 5.63\ \text{BUL} - 2{,}53\ \text{D2} \\ & (2.47)\qquad (-4.37)\qquad (-3.08)\quad (-5.53)\qquad (-2.29) \\ & - 2.73\ \text{D3} - 2.34\ \text{D4} - 1.11\ \text{D5} - 0.99\ \text{D6} \\ & (-2.60)\quad (-2.35)\quad (-1.14)\quad (-1.03) \end{aligned}$$

$$R2 = 0.674$$

One finds a fairly well explained price behavior, which reveals an elasticity of z to debt of 1.44 which can be transformed, by differentiating both sides, into:

$$\frac{dq}{q} = -\ 1.44(1-q)\ \frac{dD}{D}.$$

Call V = qD the market value of debt, one gets

$$(8)\ \frac{dV}{V} = [1 - 1.44\ (1-q)]\ \frac{dD}{D}$$

There is consequently a threshold price for which the elasticity of price with respect to debt is (in absolute value) smaller than one. The price, here, is

$$q^* = 0.31 \text{ cents.}$$

In part coincidently, this price is not significantly different from the average price (=O.35) of the representative middle income debtor at the end of 1989.

One can also rewrite equation (8) as:

$$\frac{dV}{V} = 1.44\ [q-q^*]\ \frac{dD}{D}\ ,$$

or equivalently, we can write that the marginal price is :

$$\rho = 1.44\ (q-q^*)\ q.$$

Below that price q* there is a case of "debt Laffer curve" as Krugman (1988) puts it. Reducing the face value of the debt may *raise* its market value. As I emphasized in my earlier paper, however, there are only very few countries for which -with 95 % confidence- this mechanism is bound to appear. Around that threshold point, however, we can take the marginal price of the debt to be nil. Lenders, as a whole, are essentially indifferent between one more or one less dollar on their books. For countries which would repurchase their debt to the left of the price q*, the deal would offer the bankers a "boondogle", as Bulow and Rogoff have put it for the Bolivian buy-back which occurred in 1987.

2 - Test of the seniority hypothesis

A simple test of the seniority hypothesis amounts to analyzing the significancy of the composition (among private and public creditors) of the total debt on the price of the commercial debt. Let us call Lpuddet Governement and IFIs'claims on developping countries. The results are given in equation (6).

$$\begin{aligned} LPFIN = {} & 2.748 + 4.93\ OPEN - 1.248\ LDET2 - 0.23 LPUDDET \\ & (0.97)\ \ (2.76) \qquad\quad (-3.40)\ \ \ (-1.24) \end{aligned}$$

$$\begin{aligned} & - 0.26\ RES85 + 1.48\ TOT + 45.7\ G2 - 2.34\ PER - \\ & (1.79) \qquad (1.31) \qquad (2.73) \qquad (-3.59) \end{aligned}$$

1.41 POL - 5.41 BUL - 2,38 D2 - 2.65 D3 - 2.30 D4 -
(-2.84) (-5.27) (-2.16) (-2.53) (-2.30)

1.11 D5 - 1.07 D6
(-1.16) (-1.11)

$$R2 = 0.68$$

We see that public debt has no significant additionnal power (at the 5% degree of confidence). This points to the view that the pricing of the debt is indifferent to its composition. If more IFIs debt does not depress (when holding the aggregate level constant) the price of the commercial debt, this rejects the seniority hypothesis. Indeed, if the IFIs' debt were senior, then -ceteris paribus- more of it (holding the agregate debt constant) would reduce the share of the pie that the commercial banks are expecting to get and should degress the commercial debt's price. (Now it may also be the case that two conflicting effects are at work. More IFIs money may depress the price of the commercial banks on the one hand, but it can also raise the prospect of growth of the country so that, at the end, the banks would get a lower slice of a larger pie).

3 - The price of African debt

Using equation (5), one can then estimate for each African country what would have been the price of the debt, had the debt been quoted, on grounds similar to other indebted countries. The results are shown in Table A4.

We find a large spectrum of cases, ranging from a Bostwana priced essentially at par, to Uganda, priced below the threshold of 31 cents.

From these estimates, one can then proceed to calculate what would the debt to exprot ratio for which the discount could be limited to 25%. This is shown in table 4. For Africa as a whole the number is: 211%.

CONCLUSION

We have attempt to address, from three different view points, the debt sustainability question. We unambiguously obtained that the debt crisis of the 1980s played a significant role in explaining the growth slowdown of Latin America and Africa.

We then attempted to measure what could be an appropriate debt-to-export target. If one takes a "perpetuity" view on the debt, it is reasonnable to assess what could be the share of a country's exports that have to be foregone if the country was to service it debt indefinitely. One get that African country should denote about one third of their resources to servicing the debt. This is about three times what the large debtor actually transferred in the eighties !

In order to analyze what could be an appropriate write down of the debt, we then estimated an econometric evaluation of African debt and investigated which write down would bring the price the debt up to 75 cents in the dollar. We got that such a target would yield a debt to export ratio of about 210 %. This is not far from the average value of the debt-to-export ratio that was reached when countries first intered into the debt crisis in the 80's ; at the time an average ratio of 250% was the threshold alone which a country's debt needed to be rescheduled. Altogether we then trust that a debt to export ratio between 200 and 250% is a reasonable target for debt forgiveness.

APPENDIX

Debt sustainability and the risk of debt repudiation

The analysis of the risk of debt repudiation has been brought to life by the work of Eaton and Gersovitz (1981). Early work on the topic also include Kharas (1984), Kletzer (1984), Krugman (1985), Ozler (1986) and Cohen and Sachs (1986). One can read the useful survey by Eaton, Gersovitz and Stiglitz (1986) as well as the other papers in the special issue of the *European Economic Review* (June 1986) for an overlook of the state of the theory in 1985. An earlier useful survey is McDonald (1982). More recently a second generation of models of debt repudiation have applied the tools of modern bargaining theory to the analysis of debt rescheduling. The pioneering paper, here, is Bulow and Rogoff (1989a). Other early papers in this area include O'Connell (1988), Eaton (1989) and Fernandez and Rosenthal (1988).

The key to all such analyses is to determine the determinants of debt repayment, when taking account of the risk of debt repudiation. What kind of sanctions are necessary to induce a country to repay its debt? What are of the lessons of the debt crisis of the 1980's for assessing their empirical magnitude? These are the questions that I would now want to adress.

For simplicity of the analysis, let us assume that the country is inhabited by a representative consumer who is endowed each period with a quantity $(Q_t)_{t\geq 0}$ of the numeraire. We assume that Q_t is a continuous process whose present discounted value (at world interest rates) is finite. Let us start by assuming that the country (i.e. its representative agent) has a free access to the world financial market.

Let us take the utility of the representative agent to be of the following separable form :

$$(7) \qquad U = \int_0^{\infty} e^{-\delta t}\, u(C_t)\, dt \qquad \text{with } u(C_t) = \frac{1}{\gamma} C_t^{\gamma}$$

$$\text{if } \gamma \neq 0 \text{ and } u(C_t) = \text{Log } C_t \text{ if } \gamma = 0.$$

with $\lambda = 1\text{-}1/\sigma$ and σ the intertemporal elasticity of substitution.

The agent's debt follows a law of motion :

$$(8) \qquad \dot{D}_t = r\, D_t + C_t - Q_t$$

and is subject to the transversality condition : $\lim_{t \to \infty} e^{-rt} D_t = 0$

The first order condition has the form :

$$(9) \qquad \dot{C}_t / C_t = \sigma\, [r-\delta]$$

so that three cases emerge.

1) $r < \delta$, the country is more "impatient" than the representative investor in the world financial market. In that case, the growth rate of consumption is negative and, asymptotically, the country drives itself to starvation by accumulating an external debt whose services eventually eats out the country's resources.

2) $r < \delta$

The reverse situation occurs. The country is more patient than the rest of the world and -asymptotically- owns the entire world. The assumption that the country is "small" with respect to the world financial market could obviously not be maintained in this case. It is a case that we shall not investigate here since -at any rate- the country is asymptotically a creditor rather than a debtor.

3) $r = \delta$

This is the threshold case when the country's subjective discount factor coincides with the world rate of interest. The country (i.e., again its representative agent) seeks to maintain a flat pattern of consumption over time.

The risk of debt repudiation

Let us now assume that the country has the option of repudiating its external debt. We do not investigate, here, the bargaining implications of debt repudiation and simply assume that the country defaults whenever the level of welfare that it would reach by servicing its debt goes below the reservation level of welfare that it would have access to by defaulting. Let us now describe such a reservation level.

When a country defaults, we shall assume that the creditors cut all access of the country to the world financial market either as a debtor or as a creditor. This implies, in particular, that the country cannot accumulate reserve after it has defaults. This is an important restriction as the work by Bulow and Rogoff (1989b) has shown (see below). *Second*, we also assume that a defaulting country loses a fraction λ of its income so that its post-default pattern of consumption is simply :

$$(10) \qquad C_t = (1-\lambda)\, Q_t$$

The particular case $\lambda = 0$ is of interest in its own right and corresponds the case when the creditors' sanction against a defaulting debtor amounts to imposing financial autarky forever after the debtor has defaulted. We now want to investigate what is the equilibrium pattern of consumption under this threat of potential repudiation.

Let us call $\bar{D}_t$ the credit ceiling that the creditor will have to impose on the country so as to avoid default.

Call

$$(11) \quad \underline{U}_t = \int_t^{\infty} e^{-\delta(s-t)} \; u[Q_s(1-\lambda)] \; ds$$

the reservation level of welfare that the country has access to by defaulting. $\bar{D}_t$ must be set so as to guarantee that

$$(12) \quad \forall t \geq 0 \; , \; U_t \geq \underline{U}_t$$

in which $U_t = \int_t^{\infty} e^{\delta(s-t)} \; u \; [C_s] \; ds$ measures the level of welfare associated with "servicing" the debt. In order to characterize $\bar{D}_t$ (and to definie more specifically how the "service" of the debt is optimally spread out by the creditors), we shall prove the following :

Proposition :

On any time interval]a,b[on which the constraint (12) binds, the country services $P_t = \lambda \; Q_t$ to its creditors.

In the particular case when $\lambda=0$, Proposition 1 shows that the country will not service its debt on those time intervals during which it is rationed. In a different framework (when the country *can* accumulate reserves after it has defaulted) Bulow and Rogoff (1989b) have shown that short of direct sanctions ($\lambda=0$) a country will never service its debt. This is not quite what proposition 1 shows. In the framework that we analyze, it can indeed very well be the case that the country will decide to service its debt on those time intervals when it is *not* rationed (see below). In Bulow and Rogoff's analysis, these intervals correspond to the times when the country would accumulate reserves.

Proof - The proof of the Proposition is straightforward. Assume that

$$\int_t^{\infty} e^{-\delta(s-t)}\, u[Q_s(1-\lambda)]\, ds = \int_t^{\infty} e^{-\delta(s-t)}\, u[C_s]\, ds$$

on a time by interval]a,b[. Differentiating both sides yields:

$$u\,[Q_t(1-\lambda)] = u(C_t)$$

so that $C_t = Q_t(1-\lambda)$. QED.

Take the case of an economy which is exogenously growing at a constant rate $n > 0 : Q_t = Q_0\, e^{nt}$. If $\delta > r$, we know that the credit ceiling will be binding one day or the other. Indeed, consumption would otherwise fall to zero while the productive capacity of the country would grow exponentially. For any value of $\lambda < 1$, defaulting has to become a superior option. Conversely, when the credit ceiling starts to bind, we also know that it will bind forever. Indeed, given the homogeneity of the utility function it is straightforward to show that the credit ceiling constraint is simply growing exponentially at the rate n. We can then simply characterize the credit ceiling $\bar{D}_t$ through equation (13) and get :

$$(13') \quad \bar{D}_t = \frac{\lambda\, Q_t}{r - n}$$

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TABLE A1: CAUSES OF GROWTH SLOWDOWN (in %)

	Worlwide	Structural effects	Investment	Terms of trade	Debt	Residual	Total Effect
Burkina Faso	-0.27	+0.05	+0.60	+0.17	-	-2.13	- 1.59
Cameroun	-0.27	-0.11	+0.53	-1.16	-0.39	-10.28	-11.69
Centre Afrique	-0.27	+0.16	+0.37	-0.65	-0.79	+ 1.29	+ 0.12
Cote d'Ivoire	-0.27	+0.38	-0.94	-0.94	-1.97	- 0.90	- 4.64
Ghana	-0.27	-0.84	-0.19	-1.03	+0.39	+ 3.81	+ 1.87
Kenya	-0.27	+0.28	-0.48	-0.59	-	+ 1.11	+ 0.05
Malawi	-0.27	-0.17	-0.98	+0.24	-1.18	- 2.27	- 4.64
Mauritania	-0.27	+0.45	-0.09	+0.19	-1.97	+ 1.09	- 0.60
Mauritius	-0.27	+0.38	-0.23	+1.32	-	+ 3.09	+ 4.30

	Worldwide	Structural effects	Investment	Terms of trade	Debt	Residual	Total
Nigeria	-0.27	+0.67	-1.27	-0.98	-1.97	+4.32	+0.50
Rwanda	-0.27	+0.45	+0.44	-1.18	-	-7.98	-8.53
South Africa	-0.27	+0.38	-0.29	-3.92	-	+2.92	-1.18
Tanzania	-0.27	+0.38	-0.05	-0.25	+0.39	+3.96	+4.17
Zaïre	-0.27	+0.20	+0.71	-0.07	-	+1.60	+2.17
Zambia	-0.27	+0.43	-1.38	+0.73	-1.18	+2.94	+1.27
Zimbabwe	-0.27	-0.11	-0.43	+0.08	-	+3.02	+2.29

	Worldwide	Structural effects	Investment	Terms of trade	Debt	Residual	Total
Benin	-0.27	+0.19	-0.23	-0.50	-0.54	+0.35	-1.01
Burundi	-0.27	-0.35	-0.30	+0.24	-0.39	-2.28	-3.36
Chad	-0.27	-0.36	-0.22	-1.93	-0.79	+8.87	+8.10
Gambia	-0.27	-0.08	-0.62	-0.52	-1.18	+2.14	-0.53
Guinée-Bissau	-0.27	+2.62	-0.42	+0.17	-1.58	+9.71	10.22
Madagascar	-0.27	+0.32	-0.53	-0.54	-1.97	+4.05	+1.05
Mali	-0.27	-0.37	-0.03	+0.16	-	+0.50	-0.01
Niger	-0.27	+0.56	-0.48	+0.44	-1.97	-2.68	-4.39
Togo	-0.27	-0.62	-0.27	+0.54	-1.18	-0.80	-2.60

TABLE A2: SOLVENCY INDEX AND NET TRANSFERS IN LATIN AMERICA

b = (r-n) D/Q (in %)

	85 - 88	89 - 93	Net transfers (1984-89)
Argentina	4.9	3.9	2.3
Belize	2.1	1.3	0.1
Bolivia	11.7	5.3	1.1
Brazil	2.1	3.7	2.4
Chile	3.4	1.8	2.8
Colombia	2.6	2.7	-
Costa Rica	7.5	4.3	3.7
Dominican Republic	6.3	5.1	0.4
Ecuador	7.1	7.6	0.8
El Salvador	3.3	2.8	0.5
Guatemala	3.6	2.4	1.2
Guyana	41.0	33.0	4.8
Haïti	3.5	5.7	2.04
Honduras	5.4	6.0	1.5
Jamaïca	10.3	7.0	1.42
Mexico	7.1	5.1	4.7
Nicaragua	31.3	36.6	-17.8
Panama	13.9	6.13	3.1

TABLE A2 (Sequel)

$b = (r-n)D/Q$

	85 - 88	89 - 93	Net transfers (1986-89)
Paraguay	4.5	3.3	-0.50
Peru	4.9	10.6	-0.62
St-Lucia	0	1.0	-2.20
Trinidad and Tobago	4.9	4.5	1.1
Uruguay	2.4	5.4	3.6
Venezuela	5.0	5.4	5.7
Latin America	10.4	7.1	-0.15

TABLE A3: SOLVENCY INDEX IN AFRICA

1985-1993

b = (r-n)D/Q.(in %)

Benin	5.8	Mali	8.1
Bostwana	1.2	Mauritania	16.5
Burkina Faso	2.9	Mauritius	2.2
Burundi	8.0	Mozambique	22.6
Cameroon	6.1	Niger	6.9
Cape Verde	3.9	Nigeria	7.2
Centre Afrique	5.9	Rwanda	4.4
Chad	4.1	Senegal	5.7
Comorros	6.7	Seychelles	2.7
Congo	16.3	Sierra Leone	13.7
Cote d'Ivoire	17.7	Somalia	21.1
Gabon	5.3	Swaziland	2.4
Gambia	9.3	Tanzania	20.5
Ghana	4.8	Togo	10.0
Guinea	6.9	Uganda	5.6
Guinea Bissau	19.3	Zaïre	10.9
Kenya	7.6	Zambia	18.4
Lesotho	4.6	Zimbabwe	5.2
Madagascar	13.9	Africa	9.0
Malawi	7.6		

TABLE A4

Estimated secondary market price

	1988	1992	Debt to export ratio associated to a 25% discount
Benin	0.52	0.59	1.64
Bosturina	0.98	0.99	-
Burkina Faso	0.78	0.85	4.74
Burundi	0.38	0.34	2.72
Cameroon	0.68	0.62	1.80
Centre Afrique	0.21	0.36	1.43
Chad	0.68	0.56	1.73
Cote d'Ivoire	0.08	0.05	0.33
Gambia	0.32	0.71	1.45
Ghana	0.40	0.64	2.69
Guinea	0.23	0.17	0.62
Guinea Bissau	0.09	0.06	2.33
Kenya	0.57	0.81	3.94
Madagascar	0.04	0.07	0.66
Malawi	0.32	0.62	2.62
Mali	0.39	0.33	1.71
Mauritania	0.08	0.39	1.69
Mauritius	0.96	0.99	5.39
Mauzambique	0.13	0.16	2.15
Niger	0.14	0.19	0.90

TABLE A4 (sequel)

	1988	1992	Debt to export ratio associated to a 25% discount
Niger	0.14	0.19	0.90
Nigeria	0.09	0.24	0.50
Rwanda	0.74	0.79	9.62
Senegal	0.16	0.22	0.48
Sierra Leone	0.21	0.29	1.87
Tanzania	0.13	0.20	2.35
Togo	0.36	0.32	0.77
Uganda	0.53	0.10	1.56
Zambia	0.15	0.15	0.79
Zimbabwe	0.81	6.88	3.97
Africa	0.39	0.43	2.11

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